

Attn: Dr. Amrhein  
Dr. de Groot

Docket No.: NHL-SCT-16

WHAT IS CLAIMED IS:

1. A zinc-containing optical glass with a refractive index ( $n_d$ ) being substantially in the range of from about 1.52 to about 1.66 and an Abbe number ( $v_d$ ) being substantially in the range of from about 35 to about 54, said zinc-containing optical glass substantially comprising, on an oxide basis, the composition of:

<u>Material</u>	<u>Percentage</u> <u>by weight</u>
SiO <sub>2</sub>	38 - 58
ZnO	0.3 - 42
PbO	0 - <30
with ZnO+PbO	20 - 55
Li <sub>2</sub> O	0 - <3
Na <sub>2</sub> O	0 - 14
K <sub>2</sub> O	0 - 12
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2
F	0 - 3
MgO	0 - 6
CaO	0 - <5
SrO	0 - 6
BaO	0 - <0.9
B <sub>2</sub> O <sub>3</sub>	0 - <1
Al <sub>2</sub> O <sub>3</sub>	0 - <1.5
ZrO <sub>2</sub>	0 - <2.

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2. The zinc-containing optical glass according to claim 1 and further comprising an at least one refining agent, said refining agent being in an amount indicating sufficient agent to refine said zinc-containing optical glass.

3. An optical element comprising the zinc-containing optical glass as claimed in claim 1.

4. The zinc-containing optical glass according to claim 1 with a refractive index ( $n_d$ ) being substantially in the range of from about 1.54 to about 1.64 and an Abbe number ( $v_d$ ) being substantially in the range of from about 40 to about 52, said zinc-containing optical glass substantially comprising, on an oxide basis, the composition of:

<u>Material</u>	<u>Percentage</u> <u>by weight</u>
SiO <sub>2</sub>	39 - 54
ZnO	12 - 41
PbO	6 - 22
with ZnO+PbO	31 - 52
Li <sub>2</sub> O	0 - <3
Na <sub>2</sub> O	0 - 13
K <sub>2</sub> O	0 - 11
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2
F	0 - 3
MgO	0 - 6

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CaO	0	- <5
SrO	0	- 6
BaO	0	- <0.9
B <sub>2</sub> O <sub>3</sub>	0	- <1
Al <sub>2</sub> O <sub>3</sub>	0	- <1.5
ZrO <sub>2</sub>	0	- <2.

5. The zinc-containing optical glass according to claim 1 with a refractive index ( $n_d$ ) being substantially in the range of from about 1.56 to about 1.63 and an Abbe number ( $v_d$ ) being substantially in the range of from about 42 to about 52, said zinc-containing optical glass substantially comprising, on an oxide basis, the composition of:

<u>Material:</u>	<u>Percentage</u> <u>by weight</u>
SiO <sub>2</sub>	40 - 55
ZnO	26 - 41
PbO	1 - 16
with ZnO+PbO	31 - 48
Li <sub>2</sub> O	0 - <3
Na <sub>2</sub> O	0 - 12
K <sub>2</sub> O	0 - 10
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2
F	0 - 3

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MgO	0 - 6
CaO	0 - <5
SrO	0 - 6
BaO	0 - <0.9
B <sub>2</sub> O <sub>3</sub>	0 - <1
Al <sub>2</sub> O <sub>3</sub>	0 - <1.5
ZrO <sub>2</sub>	0 - <2.

6. The zinc-containing optical glass according to claim 1 with a refractive index ( $n_d$ ) being substantially in the range of from about 1.60 to about 1.63 and an Abbe number ( $v_d$ ) being substantially in the range of from about 43 to about 47, said zinc-containing optical glass substantially comprising, on an oxide basis, the composition of:

<u>Material</u>	Percentage by weight
SiO <sub>2</sub>	40 - 47
ZnO	32 - 41
PbO	5 - 14
with ZnO+PbO	40 - 48
Li <sub>2</sub> O	0 - <3
Na <sub>2</sub> O	0 - 12
K <sub>2</sub> O	0 - 10
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2
F	0 - 3

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MgO	0 - 6
CaO	0 - <5
SrO	0 - 6
BaO	0 - <0.9
B <sub>2</sub> O <sub>3</sub>	0 - <1
Al <sub>2</sub> O <sub>3</sub>	0 - <1.5
ZrO <sub>2</sub>	0 - <2.

7. A zinc-containing optical glass with a refractive index ( $n_d$ ) being substantially in the range of from about 1.57 to about 1.59 and an Abbe number ( $v_d$ ) being substantially in the range of from about 48 to about 52, said zinc-containing optical glass substantially comprising, on an oxide basis, the composition of:

<u>Material</u>	<u>Percentage</u> <u>by weight</u>
SiO <sub>2</sub>	41 - 50
ZnO	30 - 40
PbO	0 - 1
with ZnO+PbO	31 - 41
Li <sub>2</sub> O	0 - <3
Na <sub>2</sub> O	0 - 11
K <sub>2</sub> O	0 - 10
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2
F	0 - 3
MgO	0 - 6

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CaO	0	-	<5
SrO	0	-	6
BaO	0	-	<0.9
B <sub>2</sub> O <sub>3</sub>	0	-	<1
Al <sub>2</sub> O <sub>3</sub>	0	-	<1.5
ZrO <sub>2</sub>	0	-	<2.

8. The zinc-containing optical glass according to claim 1 and further comprising up to about 5% by weight of one member of the group and combinations thereof: Rb<sub>2</sub>O, La<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, and GeO<sub>2</sub> to precisely adapt the optical properties of said zinc-containing optical glass.

9. The zinc-containing optical glass according to claim 1 and further comprising up to at most about 2.5% by weight of Cs<sub>2</sub>O.

10. The zinc-containing optical glass according to claim 1 with the pure transmission of the glass, determined at a wavelength of 400 nm and 25 mm specimen thickness, being at least about 0.98.

11. The zinc-containing optical glass according to claim 1 and further containing up to about 8% by weight of a coloring component.

12. The zinc-containing optical glass according to claim 11 wherein said coloring component is a member of the group and combinations thereof: CuO, Cr<sub>2</sub>O<sub>3</sub>, CoO, Fe<sub>2</sub>O<sub>3</sub>, MnO, NiO, and V<sub>2</sub>O<sub>5</sub>.

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13. An optical filter comprising the zinc-containing optical glass according to claim 11.

14. The zinc-containing optical glass according to claim 1 and further containing in total up to about 1% by weight of a refining agent.

15. The zinc-containing optical glass according to claim 14 wherein said refining agent is present in an amount of about 0.5% by weight.

16. The zinc-containing optical glass according to claim 15 wherein said refining agent is at least one member of the group and combinations thereof:  $\text{As}_2\text{O}_3$  and  $\text{Sb}_2\text{O}_3$ .

17. The zinc-containing optical glass according to claim 1 wherein the content of  $\text{ZnO}$  plus  $\text{PbO}$  is in the range of from about 21 to about 55% by weight.

18. The zinc-containing optical glass according to claim 1 wherein the total content of  $\text{CaO}$  plus  $\text{SrO}$  is in the range of from 0 to 5% by weight.

19. A method of forming zinc-containing optical glass which consists of, on an oxide basis:

<u>Material</u>	<u>Percentage</u> <u>by weight</u>
$\text{SiO}_2$	38 - 58
$\text{ZnO}$	0.3 - 42
$\text{PbO}$	0 - <30

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with ZnO+PbO	20	-	55
Li <sub>2</sub> O	0	-	<3
Na <sub>2</sub> O	0	-	14
K <sub>2</sub> O	0	-	12
with Li <sub>2</sub> O+Na <sub>2</sub> O+K <sub>2</sub> O	≥2		
F	0	-	3
MgO	0	-	6
CaO	0	-	<5
SrO	0	-	6
BaO	0	-	<0.9
B <sub>2</sub> O <sub>3</sub>	0	-	<1
Al <sub>2</sub> O <sub>3</sub>	0	-	<1.5
ZrO <sub>2</sub>	0	-	<2

said zinc-containing optical glass having a refractive index ( $n_d$ ) substantially in the range of from about 1.52 to about 1.66 and an Abbe number ( $v_d$ ) substantially in the range of from about 35 to about 54, said method including the steps of:

(a) mixing and melting raw materials comprising said oxides to form a batch of glass;

(b) heating a batch of glass obtained in accordance with step (a) to produce a melt of zinc-containing optical glass;

(c) refining said melt obtained in accordance with step (b) with at least one refining agent, said refining agent being added in an amount sufficient to refine said zinc-containing



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optical glass.

20. The method according to claim 19 and further including the step of:

(d) homogenizing said batch of refined zinc-containing optical glass obtained in accordance with step (c).

21. The method according to claim 19 wherein said heating in accordance with step (b) is carried out at a temperature in the range of from about 1300 degrees Celsius to about 1350 degrees Celsius; and said refining in accordance with step (c) is carried out at a temperature in the range of from about 1300 degrees Celsius to about 1400 degrees Celsius.

22. The method of claim 19 wherein said refining agent is added in an amount of up to about 0.5 % by weight to said heated melt of zinc-containing optical glass obtained in accordance with step (b).